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New tools for Automated Particle Deagglomeration of micro/nano particles: Machine-Learning from Mineralogy Data

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The traditional macroscale classification of rocks has depended on mineral composition and morphology, such as size, angularity, or mineral association. Traditionally, optical petrography by skilled, experienced professionals was used for this purpose. However, when moving in the low micron or sub-micron size scale, the ability for traditional optical analysis for mineral characterization is becoming increasingly complex, if not impossible. Though there are techniques for bulk identification of ultra-fine grain sizes, such as X-ray fluorescence, Short-Wave infrared, and Fourier Transform Infrared, all these techniques do not provide information on the grain size or shapes. However, electron microscopic techniques allow us to map out particles and pores in the sub-micron size regimes. In contrast, technologies like Automated Mineralogy allow for the rapid analysis and classification of large volumes of material.

However, Automated Mineralogy is limited in its ability to recognize individual particles in a granular specimen, as it relies on programmatic and rules-based methods to deagglomerate particles, defined as a mineral area surrounded by background phases. This is especially noticeable for fine particle-size specimens, where traditional physical deagglomeration techniques are limited to “breaking” up touching particles, creating misidentification of multiple touching particles as irregularly shaped particles, which a trained analyst could recognize. We describe a new automated mineralogy computational tool for particle classification and analysis, leveraging the general classification capacity of large neural networks (deep-learning), multi-label classification, and established computer-vision (machine-learning) techniques to improve particle deagglomeration across various granular specimens.